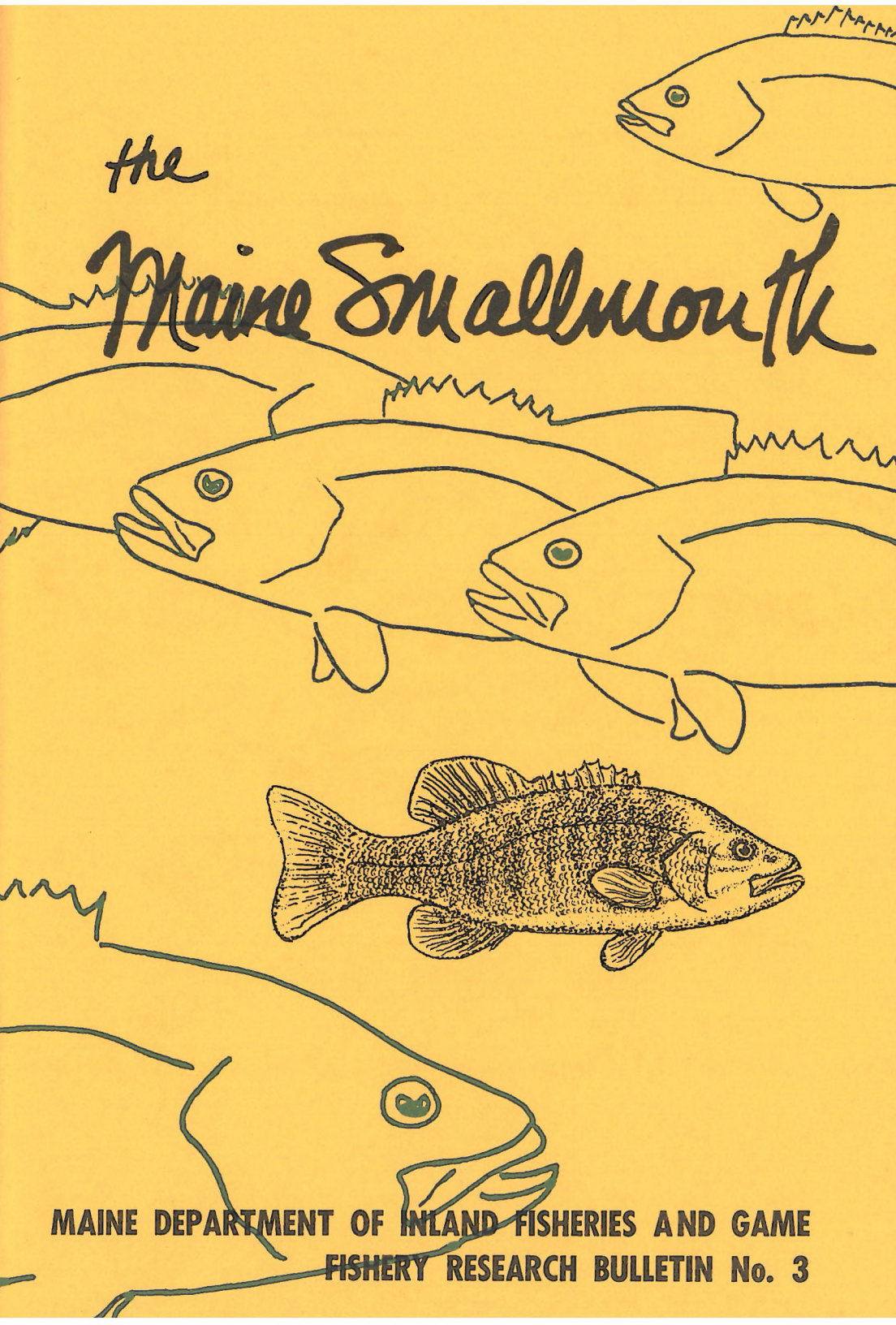
the Maine Smallmouth



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THE MAINE SMALLMOUTH

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THE MAINE SMALLMOUTH

INTRODUCTION

The smallmouth bass is one of America's prized game fishes. It has been a resident of Maine's waters for so long that Maine fishermen are often startled to learn that the smallmouth is from 'away'. Yet before the Civil War there were no bass in Maine. The original distribution of the smallmouth probably included the St. Lawrence, Ohio, and upper Mississippi Rivers, and the Great Lakes. The first Maine stocking was made in 1869, and the smallmouth adapted easily to some of our shallow northern lakes. In those days fishery biology was unknown. There was no one to survey our lakes and tell sportsmen that some of our waters were good only for bass, and that others were good only for trout and salmon, and that still others of our lakes were 'in-betweens' that could support bass, trout, and salmon for a while — until the hardier bass finally drove out the trout and salmon. While men knew that an acre of woodland would support only a limited number of decent-sized trees, they felt that any lake should support all kinds and numbers of fishes; all you had to do, they believed, was plant fish and joint up your rod. Fewer people fished in those days, too, and our lakes seemed so bountiful that Rangeley farmers could net the blueback trout on its spawning runs and use wagon-loads of these handsome fish to fertilize their farmlands.

If the smallmouth was occasionally introduced into the wrong kind of lake — one of those 'in-between' lakes suited to salmon and trout as well as the bass — what matter? Even if the bass did thrive at the expense of the more selective trout and salmon in these 'marginal' lakes, there was plenty of good water upcountry. No one worried. Men planted the bass widely. By 1900 the bass had found a home as far Down East as Washington County. Some of these hit-or-miss plantings were fortunate indeed, for they created a good sport-fishery in rather barren waters. But other haphazard plantings were tragic. Salmon and trout fishing occasionally suffered, and Man was quick to blame his own mistakes on the bass. Even today sportsmen sometimes ask that the bass be planted in unsuitable waters. Nowadays our State is equipped to

study requests for new introductions and to give an answer that is fair to all our sportsmen. Today the bass ranges as far north as Aroostook's Pleasant Pond, a lake that is best suited to our native salmon, although Man has tried to stock that lake with bass and brown trout.

How much is the bass worth to the State of Maine? In our Big Lake smallmouth study we found that the average angler paid $11 per pound for his bass. It would be more accurate to say that the $11 per pound was paid for the *pleasure* of the harvest. Only 1 bass fisherman in 100 was a Maine resident. The total value of the Big Lake smallmouth fishery, we found, amounted to a minimum of $240,000 from June 1 to Labor Day each year, or about $80,000 per month to two small communities whose combined population is only 1044 persons. The valuation, as we shall see later, is very conservative. The non-residents who supported this valuable fishery benefited by their expenditures, too, for competent guides and comfortable accommodations are not found in areas of poor fishing economy.

Big Lake in Washington County, Maine was chosen for a 2-year smallmouth study that began in 1952. This little booklet gives the highlights of that study, and it is printed for two reasons:

1. to record for all interested persons the facts about bass management in Maine, and
2. to give the sportsman an increased pleasure that comes with a better understanding of his fish.

Our Big Lake study used the best methods that fishery science could give to us, but we will use no technical terms here. We believe that the sportsman has no more time to master a technical fishery vocabulary than we have to learn the complex terms of, say, carpentry or law. But, for the reader who wishes to dig deeper into the world of the smallmouth, there are included two sections at the end of this booklet: the first, 'Suggested Reading', lists some of the better books and papers devoted to fishes; the second, 'Scientific Names', merely identifies some fishes and parasites for the reader who may know them by another common name. Altogether, the smallmouth has 36 different names. In some areas of the South, for example, one hears the smallmouth called 'green trout', but the scientific name is the same everywhere. The name 'bass' whenever it is used in this booklet refers only to the smallmouth. On the few occasions that the largemouth bass is mentioned, its complete name will be used.

Fish and Game Commissioner Roland H. Cobb had two important reasons for establishing the Big Lake Bass Study in 1952. First, there was a scarcity of factual knowledge about the bass in Maine. The bulk of Maine fishery study had been devoted to the trouts and salmon, mainly because of local preference for trout and salmon fishing. But sportsmen, guides, resort owners, and Fish and Game officials were aware of the constantly increasing value of the bass as a major part of Maine's travel and resort industry. They saw the need for facts to make sensible laws. Existing bass laws had been based upon studies made in states other than Maine, upon the scattered observations of individuals, and all too often merely upon sentiment. As often happens with laws made by public vote when there is a shortage of facts, individuals and groups frequently disagreed about the fairness of our bass legislation.

The second reason for the study was the need for facts in deciding whether to introduce the bass into new areas, and whether it was necessary to re-stock the bass in areas sometimes reported as having the 'strain' weakened by inbreeding. The idea of wild creatures 'breeding out the strain' was, to our way of thinking, sheer nonsense, and we wanted facts to show the sportsman that re-stocking to 'improve the breed' was a frittering away of State moneys.

Big Lake was chosen for our bass study because:

1. It is *one of several* important bass fishing centers in Maine. Facts gathered at Big Lake would be helpful in planning management for other areas.

2. Big Lake has supported a good population of smallmouths for over 50 years. Even in 1900 the Big Lake smallmouth provided an attractive sport fishery.

3. Since at least 1934 Big Lake has been managed under a law permitting the capture of three legal bass per day on flies only from June 1 through June 20, a law that possibly allowed some harvest of the spawning male bass. We wanted to know if that law was good or bad for the fishery.

4. Big Lake bass fishing was known to attract many fishermen from the Eastern United States. It was a good place to determine both the dollar-value of the fish to our State and the quality of fishing marketed for that dollar.

THE SMALLMOUTH

The smallmouth is one of the best known and most-sought members of the Sunfish family, and it is far more advanced in the realm of fishes than either the trout or salmon. Soft-finned, round-scaled fishes like the trout and salmon are fairly ancient of development and they are not as adaptable to different conditions as is the bass, a newer type of fish with true spines and a complicated scale structure.

The appearance of the bass is well known and is much as I have drawn him on the cover of this booklet. The jaw-opening does not extend behind the eye, and that is sufficient to rule out any confusion with the largemouth.

The bass is equipped with the normal complement of senses known to humans: sight, smell, taste, hearing, and touch. The smallmouth's vision is keen; we have seen it swim through a blinding underwater light to attack a shadow-hidden pickerel that threatened its young. Its sense of smell functions through four small openings in the forepart of its snout; water is drawn in through the two forward openings, passed over smell-sensitive tissues, and ejected from the rear openings. The bass appears to rely on both its sight and smell to secure food. Organs of taste are located in the mouth. Hearing is achieved in two ways: there is an inner ear, a complicated structure of interlocking rings that is sensitive to high-pitched sounds; and the lateral line, sensitive to low-pitched sounds, consisting of nerve-endings embedded in a jelly-like substance exposed to the surface of the body in a series of openings that run from gill-cover to tail. Reactions of the bass indicate that the surface of its body is touch-sensitive, and that some surface nerve-endings are sensitive to temperature changes.

The lateral-line, the inner ear, and the eye probably serve a combined function of stabilizing the fish in the water. Further stabilization is achieved by the air-bladder, a balloon-like organ lying inside the body just below the backbone. The air-bladder is usually ruptured when the fish is cleaned, and its presence frequently goes unnoticed. The air-bladder is filled with gas and it permits the fish to hover effortlessly at whatever level he selects. If the bass moves upward the bladder expands; if downward, it gives up some of its air and contracts. But it is the act of swimming that moves the bass up and down; the bladder merely adjusts to suspend the fish in a resting position. Some primitive fish like the shark have no

air-bladder and must swim constantly to keep from sinking down to the bottom.

The jaws of the smallmouth are covered with small inward-pointing teeth; in addition there are plate-like sets of grinding teeth well back in the throat at the level of the gills.

The body cavity is divided into two parts; the forward part is smaller and contains the heart, a small organ whose shape and function are comparable to the bulb of a medicine dropper. The heart squeezes blood through the gills where oxygen is taken from the water and moved on to other tissues.

The liver, stomach, intestine, kidneys, and reproductive organs lie in the larger rear portion of the body cavity. At the base of the stomach are a series of about 12 finger-like projections. They are single in the smallmouth, but are forked in the largemouth. The reproductive organs are two in number. They lie on either side above the stomach and they join just in front of the vent. The female reproductive organs are pale orange and when seen by the fisherman usually contain small unripe eggs. Ripe eggs are fairly large, about the size of a No. 7 shotgun pellet, and run about 10 to the linear inch. Ripe eggs contain a tiny globule of oil that is visible to the unaided eye. The male reproductive organs are grey-white and are much thinner than those of the female. The male and female bass look exactly alike, and examination of the reproductive organs is the only sure way for the average person to tell the sex of these fish; slight external differences may be noted at mating time by an experienced observer.

The kidney, an organ sometimes mistaken by the angler for congealed blood, lies against the backbone of the bass. It serves to release water from the blood. The blood of the bass, like that of humans, is salt, and it tends to draw up water from the lake that surrounds the fish. The kidney works constantly to release this water from the blood through a copious flow of urine. It is a fact that the bass never takes a drink of water; what little water gets into its food tube does so only when the bass eats.

Most Maine bass are born during the month of June. Spawning peaks vary from year-to-year with varying water temperatures, and the bulk of spawning occurs in a water temperature of 60° - 70°F.

The male bass dominates the spawning. Alone, he builds the nest and cares for the young. Normal-growing males are ready to spawn when they are about 9 inches long and 3 years old. When the water has warmed to suit the male bass — usually a temperature

in the mid-fifties — he begins nest construction. He selects a bed of coarse gravel, sheltered by an out-tilted tree or a large boulder, if such are available. The bass has been known to build its nest in water depths varying from 10 inches to 12 feet.

Using his tail fin as a sweep, the male assumes an uphill position in the water directly over the gravel of his choice and clears out a circular area whose diameter is 1½ to 2 times his length. When construction and cleaning are completed, he stands guard and waits for the female, who during these activities has been waiting in deep water. She remains in deep water until a temperature satisfactory for egg-laying is reached. The 1953 peak of spawning in Big Lake occurred at a water temperature of 64°F; nest building had commenced at about 58°F.

The nest-guarding male is very aggressive, but with patience it is possible to gain the confidence of a nesting male so that one can straddle the nest and watch him through a viewing barrel both before and after spawning. One male bass became so accustomed to my study of his nest that he swam unconcernedly between my feet. With the achievement of a suitable water temperature, the female moves in toward the nest. The male darts out to greet her and eventually succeeds in conducting her to the nest. Courtship culminates in the two fishes lying side by side over the cleared gravel. The female extrudes her eggs and the male emits the milt that fertilizes them. Egg counts show that the female carries about 8000 eggs per pound of body weight. The adhesive eggs fall to the cleaned gravel and attach themselves there. When the female has voided her eggs, she leaves for good and the male assumes complete parental care. He guards the eggs with great care; his fin movements wash away the wastes of the developing eggs and keep them surrounded with clean well-oxygenated water.

Under suitable temperature conditions, the eggs hatch in 3 or 4 days and the transparent young fish fall among the crevices of the gravel where they continue their development with an attendant darkening of color for another 3 or 4 days, finally arising from the gravel as a swarm of 'black-fry'. Total time from egg-laying to rising of the fry from the nest generally requires from 7 to 14 days and depends on temperature. Warming of the water hastens development; chilling of the water slows development; extremes in temperature can destroy the eggs. The male guards his young for 4 or 5 days after they have risen from the gravel. Each day they spread further and further along the shoreline of their birth until finally they shift for themselves.

The fry feed on tiny aquatic creatures called plankton; especially important are the tiny shrimp-like water animals that are generally known as water fleas. Careful examination of shoreline water in Maine's warm-water lakes will usually reveal these little animals at spawning time. By the time the fry have grown 1 to 2 inches long their diet includes insects and small fishes. From then on the diet is predominantly of fish and insects, although crayfish, when present, are eaten about 7 times more often than any other food item.

Male and female bass grow at the same rate. The average Big Lake bass was about 3 inches long at the end of its first year of life; 6 inches at the second year, 8½ inches at the third year, 11 inches at the fourth year, and 13 at the fifth.

Although many bass are born each year only about 1 in 1000 lives to be four years old. Conservatively speaking, about one-half of all the bass in a lake die each year, whether that lake is fished or not.

THE SMALLMOUTH'S HOME

Water, to a land-dweller, is mysterious and at times even frightening. Raise a lake's level just a few feet and the once-familiar shoreline is no longer a place that can be touched, seen, and studied with leisure. Soon it gives shelter to soft plants, jointed water-animals, and fishes. In one square-foot of that sheltered area will be locked up more secrets than any man will ever know. But with patient study man can learn much of that water area, enough to secure the best possible fish production.

Maine's lakes were formed by the retreat of a massive ice cake that had overlain most of our State. As the giant ice-mass retreated northward, it left kettle holes and horsebacks, it blocked off ancient river valleys, and it scooped out lakes that were both shallow and deep.

Maine's deep lakes are clear and cold all year round. They contain few plants and much oxygen, and they support only a limited number of food fishes. Salmon and trout prefer these lakes. Deep, clear lakes have a limited food potential and they should be reserved for salmon and trout only. Bass can and do live in the shallow areas of some of our deep clear lakes, generally to the detriment of the bass itself, as well as the salmon and trout.

But the smallmouth thrives in Maine's warm shallow lakes, and those lakes are highly unsuited to our trout and salmon. Maine is blessed with a goodly number of both kinds of lakes, and there is no reason for the bass, trout, and salmon to encroach on each other's domains — no reason, that is, except for Man's mistakes in planting fish where they don't belong.

Warm-water lakes, the habitat preferred by the bass, have some very definite and measurable qualities. We shall consider each of those qualities as they are found in Big Lake, a typical bass lake:

1. Smallmouth lakes usually have at least several hundred acres of water surface; smallmouth lakes in Maine are frequently measured in thousands of acres. Big Lake has an acreage of 11,520.
2. Smallmouth lakes are shallow. For all its vast area, Big Lake averages only 15 feet in depth.
3. Smallmouth lakes are rich in food. The water of Big Lake is cloudy with microscopic life, both plant and animal. These tiny food items are essential to the diet of bass fry, and to the diets of the yellow perch, sucker, and minnow fry that make good food for bigger bass.

4. Smallmouth lakes are rich in large water-plants. The occasional mud-bottomed coves of Big Lake are abundant with milfoils, pond-weeds, starwort, pipewort, water lilies, and similar plants that harbor water insects and provide sheltered nursery areas for small yellow perch, minnows, and suckers. These insects and small fishes are essential bass food.

5. Smallmouth lakes must contain good shoreline gravel for nest-building. Good nesting gravel averages about the size of a hen's egg, and in Big Lake constitutes nearly two-thirds of the 63 shoreline miles.

6. Smallmouth lakes often have little oxygen below the 35-foot mark in the summer. Big Lake, for example, has one small hole that is 70 feet deep. For every million particles of water in the bottom of that hole there are only 2 particles of oxygen. Even though the water at the bottom of that hole is cold enough to support trout and salmon, the oxygen content is inadequate to keep them healthy; it would be just as productive to shovel some money into Big Lake as to plant trout and salmon there. But in its warmer surface waters down to the 30-foot depth, Big Lake contains at least 5½ parts per million of oxygen, a concentration adequate for good bass-growth.

7. Smallmouth lakes should have a stable water-level during spring and early summer. The bass spawns in shallow water, and a lowering of the water-level can destroy its eggs. During the spring and early summer of 1952 and 1953 the water-level of Big Lake did not vary more than a few inches.

8. Smallmouth bass lakes should be fished by sportsmen. The female smallmouth lays, on the average, about 10,000 eggs. Fortunately many of these eggs do not hatch, but, even so, the danger exists that there will be too many young fish produced each year. If too many bass are produced, there will not be enough food to go round and the fish will become 'stunted'. About half of all the bass in a lake will die each year from natural causes, even though that lake is completely closed to fishing; and by harvesting the bass in accordance with sensible laws, the fisherman actually helps to prevent stunting and waste. We shall have more to say about sensible laws in a later section of this booklet.

In addition to our two main types of lakes, there is a third less-often-encountered type that is ' in-between ' or marginal. Marginal lakes *are* shallow, but they have just barely enough oxygen and cold water to meet requirements of trout and salmon. Bass can live well in these marginal lakes, but unfortunately, the bass, when introduced, drives out the less-hardy trout and salmon.

Since Maine has an abundance of fine natural bass lakes, the marginal waters should be reserved for trout and salmon. During the 1953 Lake Surveys, the Fishery Research and Management Division was called in to investigate an intermediate, or marginal lake that was teeming with bass. Camp-owners asked the survey crew if it would be possible to ' bring back the good salmon fishing that we used to have here '. A little research showed that the lake had indeed been a fine salmon lake, and not too many years ago. Further study showed that about 12 years ago a fisherman, thinking that he would add some variety to that lake's fishing, planted a tub of bass that he had caught in a nearby bass lake. For the camp-owners who relied upon salmon fishing for all or part of their incomes, the results are tragic, for the bass have almost completely dominated the salmon. Once the fish population of a *large* lake has been changed, there is little that the fishery biologist can do toward changing that lake back to its original state again. Fishermen should be very careful to avoid introducing new kinds of fishes. Bait pails should not be emptied into a lake.

The smallmouth is also found in some of our larger streams, but the greatest number of fishermen seek the bass in its lake environment. In streams, as in lakes, the smallmouth must have good gravel for nest-building, a good supply of clean water, and plenty of small fishes for food. Stream-fishing for bass is a splendid recreation, and stream-bass respond well to the conventional lures.

THE SMALLMOUTH'S ASSOCIATES

Maine's best bass lakes — and these are the warm-water lakes — contain other fish besides the bass. Generally one finds white perch, pickerel, yellow perch, sunfish, suckers, hornpout (brown bullhead), chubs, and minnows in smallmouth waters. Occasionally the largemouth bass is found, too, but it is not widely distributed in Maine.

We have seen that a bass over 2 inches long requires other fishes as food. Of the smallmouth's associates, the minnows and young of the yellow perch, pickerel, suckers, and sunfish provide the best fish food. Small bass, too, provide food for larger bass, and it is entirely possible that bass eat more bass than do fishermen.

Insects in their water-dwelling stage, known as nymphs to the fly fisherman, are a valuable item of bass-diet throughout the feeding season. Crayfish, a desirable bass food, are not found in some Maine bass lakes, probably because the mineral content of the water is unsuited to the shell-moulting necessary for crayfish growth. It would be useless to plant crayfish in such waters because they would not survive.

The white perch, where we have found it in bass lakes, definitely competes with the bass. It eats much the same food that the bass does. It produces vast numbers of offspring; egg counts show that the female white perch has about 40,000 eggs per half-pound of body weight. The white perch grows very slowly even under normal conditions, and it often requires over 10 years to grow 12 inches, a length reached by the bass in half that time. The large numbers of white perch produced each year tend to eat up much of the available food and become stunted; furthermore, we have never found a young white perch in the stomach of a bass. The white perch can hardly be considered an ideal food fish for the bass. In lakes that are to be managed for bass fishing, the white perch is definitely a competitor fish, and fishermen should be encouraged to thin out the white perch population; that action, besides reducing the food and space competition with the bass, would produce a better growth rate in the white perch.

In fairness to the white perch, we ought to note that it is a superb food fish, and that in lengths of 10 inches or so it is indeed to be considered a game fish. Unfortunately its major feeding periods occur from dusk to dawn, and the angler-harvest is proportionately light.

Food studies were carried out at Big Lake to determine if any item of bass diet should be protected to insure normal smallmouth growth. The findings are summed up briefly here for the information of the bass-fisherman.

The bass ate insects throughout its entire feeding season, and insects were an especially important food item during June and September. Nymphs of the dragon fly, damsel fly, stone fly, and May fly were most often taken; land beetles and ants were occasionally found in bass stomachs. Many young pickerel were eaten by the bass during the month of June, and the pickerel continued to be an important food throughout the season. Beginning in late July, young yellow perch, sunfish, chubs, shiners, and suckers formed the major portion of the diet. During August the smallmouth ate 3 times more fish than insects, but by late September insects formed the largest part of the diet. Frogs were occasionally found in smallmouth stomachs, but these were probably provided by fishermen.

The food studies show fishermen very clearly why bucktail flies like the Mickey Finn and the Edson Light and Dark Tigers were especially productive early in the season, and why spoons and live minnows tended to produce well in late July and August.

A discussion of the smallmouth's associates would be incomplete without mention of his parasites. For, like Man, the bass is sometimes troubled with small organisms.

From a fisherman's point of view, the two most obvious bass parasites are 'black spot' and 'yellow grub'. Neither of them is harmful to man, and the light infections sometimes found in Maine bass are harmless to the fish. A more serious parasite, the bass tapeworm, is found in a few Maine lakes; it is not often seen by the fisherman and is harmless to him anyhow. But the bass tapeworm is harmful to the bass and by the harm it does to the fish can affect the fishing success of the sportsman. We shall consider each of these parasites separately.

Yellow Grub

Yellow grub is aptly named. Though unsightly, it does not harm the food-value of the bass. It varies in size from a pinhead to the head of a store-match, and is particularly conspicuous in late August.

The adult yellow grub lives in the great blue heron's throat. When the heron feeds, the worm's eggs are released from the bird's opened mouth. The egg releases an active young worm into the water and it enters a snail. The worm multiplies inside the snail and its offspring then leave the snail and attack the bass. They bore into the flesh of the bass where they become walled off into tiny sacks. If the fish is then eaten by the heron, the worm is digested out and takes up residence in the bird's throat.

Yellow grub is most conspicuous about the gill region of the bass, but it can occur on all parts of the body. It is found also in the brook trout and yellow perch; guides frequently comment on the appearance of the parasite in the pickerel's gills.

The adult yellow grub has been found in the double-crested cormorant (shag) and the worm is probably carried by some other fish-eating birds. Lest anyone contemplate the wholesale slaughter of these birds, it should be recorded that these same birds may serve our bass in some helpful way that we don't yet know about. Slaughter of the birds might visit some worse trouble upon our fishes. The history of Man's attempts to change Nature does not make pleasant reading.

It should be emphasized here that the yellow grub is not harmful to man, and that cooking destroys every parasite.

Black Spot

Black spot is usually found in the skin and on the fins of the bass; occasionally it is found in the outer region of the flesh. The life-cycle of this parasite is similar to that of yellow grub, but the bird involved is the belted kingfisher: the cycle runs from the kingfisher to the snail to the fish and back to the kingfisher when it eats the fish. Oddly enough, the most unsightly part of black spot — the black coloration — comes from the coloring material in the bass itself and not from the parasite. Cooking, of course, destroys this parasite as it does all others.

Bass Tapeworm

The adult bass tapeworm lives in the finger-like projections that extend outward from the intestine just behind the stomach of the bass. The eggs of the tapeworm are shed into the water with the droppings of the fish. Tiny water animals, somewhat

similar to the water fleas, eat the tapeworm eggs and are themselves eaten as food by the young bass. The young worm then bores through the intestine of the bass and locates among the body organs. If the young bass is eaten by a larger bass, the worm is then digested out of the young fish and goes into the finger-like projections where it begins to release eggs for the start of another cycle.

BUT, if the young bass with the worm still in its body cavity is not eaten by a larger bass, it will grow up with the living worm in its body. The worm must have something to eat, and it frequently chooses the developing egg-sacs or milt-sacs because those organs are soft and easily available to the worm. The reproductive power of the fish is often destroyed. The bass tapeworm can be carried by such other warm-water fishes as the yellow-perch and the sunfishes.

Fortunately, many Maine lakes are free from the bass tapeworm. They can be kept that way. Fishermen should be scrupulously careful not to empty bait pails into any body of water. One infected fish can touch off an entire lake. Fishermen can also help by not asking for the stocking of bass. If bass already exist in a lake, they can adequately carry the fishing burden by their natural reproduction and stocking is a waste of sportsmen's dollars. A completely contradictory situation is achieved when the danger of tapeworm introduction is added to wasteful stocking.

In those few instances where rather barren warm-water lakes containing no bass are encountered in Maine, bass introductions should be carried out only by Fish and Game officials, and those introductions should be made with brood fish taken from a lake known to contain healthy smallmouths. A dozen or so brood fish can populate a good-sized lake in a very few years. The matter of introducing fish into a new area is a very serious thing and it requires serious study.

THE BIG LAKE SMALLMOUTH STUDY

The Big Lake smallmouth study was made during the summers of 1952 and 1953. Its purpose was to secure facts about the bass that would give fishermen in Maine the best possible harvest today and still preserve the fishery for the use of their grandchildren.

We learned many important facts about the Maine smallmouth in our Big Lake study; this section of our booklet will present some of the highlights of that study.

The Spawning Study

The spawning study was made to find out how long and how much the bass spawns in Big Lake.

Our most accurate spawning studies were made at night with the aid of an underwater light. The light was simply constructed. It consisted of a flat 12-inch by 12-inch sheet of stainless steel tapped in the center to accommodate a bayonet-type socket fitted with an automobile lamp. Power source was a 6-volt automobile battery. The light was reflected in a broad arc; in bass waters of mirror-smooth surface with moderate clarity, the definition of objects within a 20-foot radius was very accurate. Use of the light required a brief period of adjustment while the operator 'learned to see' in a medium that was new to his eyes. With practice many details such as the gentle fin-movement of a nest-guarding bass could be easily seen.

The underwater light functioned best when the lake surface was absolutely smooth. Any rippling of the surface caused distortion of objects and reduced the accuracy of the counts. The action of waves, however slight, affected the observations to such an extent that those counts were discarded.

Nesting males that had been timid when approached during daylight hours often showed no fear at all in the presence of the night light. Often it was possible to move the light to within an inch of the snout of a nesting male and to thoroughly examine the nest without alarming the fish. On one occasion, a male that had just spawned allowed its nose to be rubbed with the light. Female fish, in the few observations that could be made upon them, showed great timidity in the presence of the light.

The spawning study gave us the following facts about the Big Lake bass:

1. Nest-building by the males begins late in May when the water temperature is in the middle fifties.
2. The peak of spawning action is reached in mid-June.
3. Spawning ends by the middle of July.

Taking 1953 as a fairly typical year, we found that the first instance of male nest-building occurred on May 28. By June 7 a nesting male could be observed once for every 300 feet of well-graveled shoreline. Storms and high winds were common during the first 10 days of June and the surface water temperatures fluctuated between 57°F and 63°F. The maximum nest count was made on the night of June 14-15 when the temperature had risen to 64°F. That count showed 114 nesting bass over a measured mile of excellent spawning gravel. The average was one nest per 46 feet of shoreline; in areas of concentration the nests were only 12 feet apart. Average nest-depth was 3 feet; that depth is obviously due to the fact that the best gravel lay at an average depth of 3 feet below the surface, and the bass had little opportunity to nest at any other depth. The last night observation of a male bass guarding its nest was secured on June 30, and the last dead-ripe female was taken by an angler on July 7.

A careful study of Big Lake's 63 shoreline miles showed us that 37 of those miles are ideally suited to bass spawning and that at least 4218 nests were constructed. That figure does not include the shallow gravel bars in the lake where the male bass was known to construct nests, nor does it include the fact that certain ideal nesting sites had a double potential; they were used successively by two different males.

The nesting areas preferred by the male bass were those that provided both good gravel and good cover. The cover might be a boulder, a tree that had become tilted out over the water, or a tree that had actually fallen down into the water. In some areas the spreading branches of a shoreline hardwood provided desirable cover. A few nests were observed that combined several desirable features: good gravel, a boulder, and a down-fallen tree. The largest males, by their dominance over the smaller ones, seemed to reserve the best combinations of gravel and cover for their nests. Preferred nesting situations were observed on several occasions to be used twice; one such situation involved a large male whose black fry had risen and were in the process of scattering by June 15; on July 1 the same nest was occupied by a much smaller male whose fry had just risen from the gravel and were in a tight cluster over the nest.

Fishing Pressure

Fishing pressure was determined for the Big Lake Region by actually measuring the fishing success of the sportsmen. During the two study years 1358 fishermen were interviewed; of these, 11, or less than 1 per cent, were residents of Maine. Anglers from as far south as Florida and as far west as Nebraska traveled to Big Lake; the bulk of the angling population was drawn from Massachusetts, Connecticut, New York, New Jersey, and Pennsylvania.

Early in the organization of the census of these anglers' creels it became apparent that luck and fishing success have no connection. The anglers who knew from experience how to fish for bass, and who were accompanied by guides who knew the lake, were the anglers who caught the most bass, and caught bass the most consistently. For that reason, the creel census was aimed as much as possible at the level of the guided angler, so that a maximum of fishing pressure could be secured. That pressure produced a catch rate of slightly better than one bass per hour; 9 out of every 10 bass caught were released. Boat counts of the confluent Big Lake-Grand Falls Flowage area indicate that, even on days of maximum fishing pressure, anglers never had less than 500 acres of water for their personal fishing area. The catch rate varied widely among anglers, ranging from none to 10 bass per hour. The best recorded catch was made by a highly skilled lady-angler who was accompanied by a guide. Her catch in legal-sized bass for one 8-hour fishing day was 70, the largest of which was 3½ pounds with a total length of 19 inches; all were released.

The creel census indicates that fewer than 4000 bass are actually removed from Big Lake each year. Of these, 75 per cent are 5 years old or younger. We have seen that over 4000 bass nests are constructed each year in Big Lake. Each of these nests can be conservatively expected to contribute to the fishery each year at least two bass that will ultimately become 5 years old, and it is fairly obvious that the Big Lake bass more than holds its own against current fishing pressure.

Growth Studies

Bass scales are important to bass studies because they bear a record of each year in the life of the fish. The complicated structure of the bass-scale is not often noticed by fishermen. The scales lie upon the fish like round-edged shingles covered with tiny comb-like projections and are lapped over by tight-fitting folds of skin. The round-edged margins of the scales face backward toward the

tail of the bass and offer little resistance to a flow of water across their surfaces. The part of the scale seldom seen by fishermen is the forward-pointing part that is hidden by the overlap. The forward portion is shaped like a miniature hand and is embedded forward into the body. If properly removed, the scales may be used to determine the age of the fish. The bass grows new scales to replace those that have been lost.

The scales grow in proportion to the growth of the fish. Each winter when the bass takes little or no food, his body and his scales cease to grow; but when June warms the waters the bass begins to feed. Simultaneously his body and his scales start growing again, and there is left upon the scale a broken line called a year mark. At the end of its first complete year of life the bass will have formed one year mark upon his scales, and so on for each year. One has only to count the number of year marks upon a scale to determine the age of a given bass. Unfortunately, the process is not so easy as it sounds. The scales must be enlarged with a lens to about 40 times their actual size. With practice under the guidance of an experienced fishery biologist, one can achieve good accuracy with bass up to five years of age. But as the fish grows older its yearly growth becomes less and less, and the winter marks are squeezed closer and closer together upon the scale. Much patience and experience are required to secure accurate birth-dates for older bass. The oldest known bass ever to have its scale marks recorded had passed its fourteenth winter.

With a bit of reflection one can see the importance of growth rates in managing a population of bass. Abnormally slow growth generally indicates that a lake is crowded with too many under-fed bass, and that regulations should be eased to encourage fishermen to take down the numbers of small fish so that a more normal growth rate can be achieved. Ironically, when a lake is crowded with small warm-water fishes, fishermen often call it ' fished-out ', when actually the problem is one of under-fishing.

We might cite a frequently-used example and say that in any given lake Nature sets just so many places at the table — and no more. When bass are first introduced into an ideal bass lake they grow abnormally fast; there are many empty places at the table, and extra meals are easily come by. This good thing does not last. The fish multiply rapidly and soon all the places at the table are taken. Every bass has just enough to eat. The bass now grow normally, and the greatest number of fishermen will be satisfied with the fishing.

If all the fish eating at Nature's table lived and kept on multiplying there would soon be a food shortage; each fish would get only part of a meal. The condition of being half-starved would cause them to grow with abnormal slowness. We would call them stunted fish. True, there might be a few big fish left feeding at the expense of their stunted brothers. Sometimes this happens. This sad state of affairs is often brought on by fishermen themselves, who, forgetting about growth rates and selfishly hoping for bigger fish than Nature can provide, make laws to prevent even a reasonable harvest.

Fortunately there are controls. Nature tries to control the crowded table by causing at least half of all the bass in a lake to die *of natural causes* each year; Man often tries to help by reaping a sensible harvest; birds of prey and other predators try to help by reducing the numbers of bass. If all of these combined forces blend together perfectly, every fish at the table will be fed properly — the bass will grow normally and the wise fisherman will be pleased with his catch. It is the delicate job of the fishery biologist to calculate just where the fishing harvest fits into the picture.

We have determined normal bass growth rates much in the manner that one would determine the height of a growing person at a given age; we took all the bass growth rates that had been recorded in fisheries literature and averaged them. We assume that average growth is normal growth. Obviously, the growth rate of a few fish cannot be taken as a measure of a whole lake-full of fish; a fair-sized sample carefully studied is needed to give confidence in statements made about fish growth. In our Big Lake project we studied the growth rates of more than 700 bass. To save a needless waste of fish, we took scale samples and measurements from fishes that had already been captured by anglers who helped with the creel census. The growth rates of the Big Lake bass are shown graphically in Figure 1.

The smallmouth does not grow as large as some people would like to think. In our northern range the bass can be considered large when it attains a weight of two pounds; over three pounds the fish is a real prize; catches of bass weighing more than four pounds are extremely rare. But the tremendous vitality of a one-pound smallmouth makes it a splendid fish to catch.

The Value of the Big Lake Bass Fishery

It is very important that the Fish and Game Department know as closely as possible the value of the resource it is responsible for.

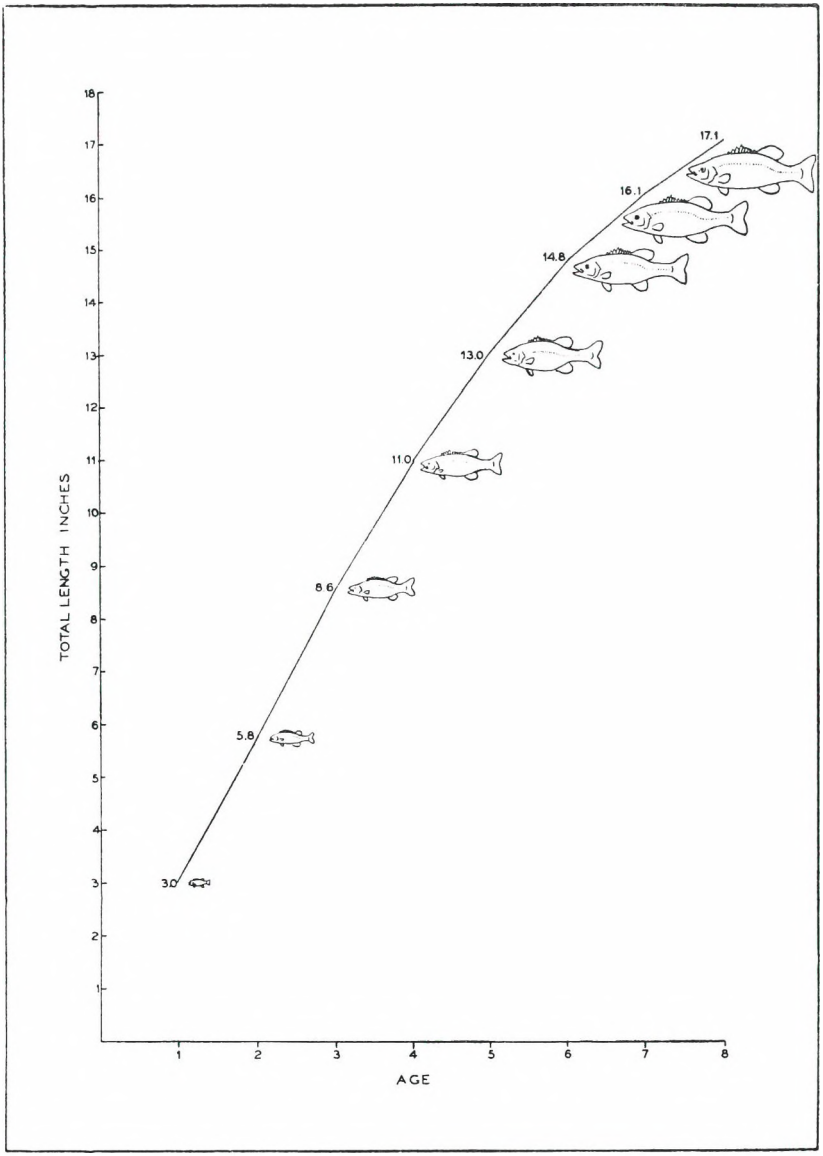

Figure 1. Growth rate of the Big Lake smallmouth bass. The curve is based upon the study of 736 bass.

Such knowledge gives confidence in making decisions regarding the future conduct of a fishery. For example, if a fishery is shown to be of little value to the State, it would be unwise to spend management funds in improving that fishery at the request of a single individual. On the other hand, if a fishery is shown to be of great value to many individuals, the State is justified in making extensive management expenditures to preserve that fishery at its highest level of efficiency.

To determine the dollar-value of the bass-fishery in the Big Lake region, facts were sought from the 1358 fishermen who were interviewed, and from those whose incomes depended directly on the bass-fishery: the Princeton-Grand Lake Stream Guides and Camp Owners Association. On the basis of these interviews the Big Lake Region Bass Fishery is calculated conservatively to be worth $240,000 each year for the 3-month period beginning on June 1 and terminating on Labor Day. The figure is based on expenditures by anglers for licenses; food and lodging; guides' wages, boats and motors; bait, tackle, and supplies; and upon the average amount spent from entrance in the State until arrival at camp.

A typically well-run resort, for example, reports an average of 340 guest weeks each year, a guest week being equal to one person residing at that resort for 7 days. Minimum cost to one angler for meals, lodging, and guide service for one day is $23, or $161 for one guest week, and 340 guest weeks are worth over $50,000. If, for the sake of a conservative estimate, it is assumed that only half of the anglers employed guides, the 340 guest weeks are still worth about $40,000, a figure that does not take into account license fees, bait, tackle and supplies, nor does it include moneys spent by the angler in traveling to the resort. There is a minimum of ten major resort units in the Big Lake area, and several persons are concerned with camp rental as an additional source of income.

The drawing power of the smallmouth is surprising. In the Princeton area 98 per cent of the fishermen were bass fishermen; the other 2 per cent were concerned mainly with trout and salmon fishing in the nearby cold water lakes. In Grand Lake Stream, a village lying at the foot of West Grand Lake about 3 miles distant from Big Lake, one resort reported 80 per cent bass fishermen, and no Grand Lake Stream resort reported less than 50 per cent bass fishermen. This is especially surprising, for West Grand Lake has long been considered a center for salmon and lake trout fishing, and specimens of the famous Grand Lake Stream 'race' of

landlocked salmon have been transported to such distant waters as the private pools of the Emperor of Japan; yet more than half of its sport-fishing economy is dependent upon the bass fishery whose nearest habitat is Big Lake. The predominance of bass fishermen is accountable in two ways: the bass is highly esteemed as a game fish by visiting fishermen, and the bass is more catchable than the salmon at a time when the greatest number of people can visit Maine, the period of time beginning with the closing of schools and ending with Labor Day.

While fishermen can rightly consider it an impertinence to have their fishing pleasure measured in terms of dollars, it is worth noting that an average of $11 per pound was paid for each Big Lake bass that was harvested. The range in cost to the angler was from $2 per pound to $87 per pound. In terms of angler-pleasure the cost was little enough.

SMALLMOUTH MANAGEMENT

Correct management of a fishery resource involves the use of regulations, even if those regulations only serve to encourage the harvesting of fish. Regulations, to some fishermen, are restrictions you place on the other fellow to insure more fish for yourself. To the unskilled fisherman, everything is 'fished out', and you need more regulations to build up stocks of fish that will be easier to catch. To the skilled fisherman, regulations are frequently an artificial measure of success: catch your limit and you have proved yourself. To many fishermen, regulations are laws that you obey, even though you're not always sure of the reason for them. To the administrator, regulations are controls whose purpose you must constantly explain. To the enforcement officer, regulations are laws that sometimes overlap and sometimes are difficult to interpret. Witness the following suggested law: '. . . that X Lake be closed to fly fishing only during the month of June.' What is your interpretation?

It is with these problems in mind that we approach the matter of smallmouth regulations. It should be kept constantly in mind that the bass is a warm-water fish and has thousands of young; fishermen have far less influence upon warm-water fishes than they imagine. The best thing a fisherman can do to conserve warm-water fishes is to take a sensible harvest, and regulations can best help by encouraging that sensible harvest. The next decade will probably witness a relaxing of our bass laws far beyond the restrictions offered here. On the basis of our study of the Maine smallmouth, we recommend that:

1. The minimum legal length, if there must be one, should not exceed 10 inches.

   REASON: The male bass is the one that is particularly vulnerable during spawning season. If he shows normal growth he will have already spawned once before he is available to capture. If he is a stunted fish and is helping to crowd a population of small fish, that is all the more reason for his being harvested. Females are seldom caught in Maine during the spawning season, and since they outnumber the males 3 to 2 there is no reason to consider them separately on the basis of their ripening at a longer length (11 inches) than the male.

2. The bass season should be made to correspond with the general law on trout and salmon.

   REASON: Few bass will be taken until late May or early June when the water has warmed to the 50°-60° bracket. As for protecting the spawning fish, our studies on a 10,000 acre Maine bass lake (Big Lake) show that if 50 per cent of the brood stock were removed at spawning time, there would still be ample spawning to serve the needs of the fishery. The only possible value of a 'flies only' law for the first 2 or 3 weeks of June is that fly-hooked bass are usually mouth-hooked and can be released without injury. Bait-hooked fish are frequently deeply gut-hooked and are hard to release without serious injury. 'Flies only' or 'single-hooked lures only' during the early season would permit a selective harvest of fish, because it would give the angler a chance to release, uninjured, fish that he wished to return to the nests.

3. The 7½ pound general limit should remain in force.

   REASON: Such a limit spreads the catch among a greater number of anglers and discourages the 'deep freeze' fisherman.

4. In those lakes where bass management is sought by the anglers, and where the white perch co-exists with the bass, all restrictions on white perch fishing should be removed.

   REASON: The white perch grows about half as fast as the bass; it produces 5 times as many young as the bass does; and it competes directly with the bass for food. Furthermore the white perch is a night feeder and many anglers wish to be off the water at dusk; as a result the bass takes the brunt of summer fishing pressure.

5. Water levels should be kept stable during the bass spawning season, approximately from May 15 to July. 15.

   REASON: The bass is a shoreline spawner. Excessive fluctuation of water levels could seriously curtail natural reproduction.

The foregoing recommendations are general in nature; local conditions may indicate modifications and those modifications should be guided by the study of a trained fishery biologist.

The Big Lake bass study showed that the following management plan was especially suited to that area:

1. No re-stocking of the bass should be permitted. Re-stocking is unnecessary, and, besides constituting a waste of Fish and Game Department funds, could result in the introduction of the bass tapeworm. Introduction of that parasite would have an extremely adverse effect upon the present fishery. Stocking of any other kind of fish to compete with the bass for food and space would be unwise. The bass that survive to spawn are select individuals, and the idea that wild creatures in natural surroundings can 'breed out the strain' should be dismissed as an old wives' tale.
2. Water levels should be maintained at normal by water-users of the area at least from May 28 through July 8, the presently-known time extremes for spawning activity of the bass. The best spawning gravel lies, on the average, at a depth of 3 feet. A lowering of the water level by that amount during spawning season could seriously lower the reproductive potential of the bass. By 'normal' is meant that level of water in Big Lake necessary to maintain at the Princeton Bridge on U. S. Route No. 1 a flow of water that is flush with the supporting crib on the west bank of Grand Falls Flowage (Kennebasis River) immediately adjacent to the bridge.
3. All bag- and length-limits on the white perch should be removed, and the white perch open season should be adjusted to correspond to the general law on trout and salmon. There is an abundance of white perch in the Big Lake Region, and the white perch is known to compete with the bass for food and space. The bass is the more desirable game fish, at least to 99 per cent of the sportsmen (the non-residents) who support the fishery.
4. Bass regulations existing for the Big Lake Region in 1952 and 1953 permitted the harvest of 3 bass on flies only from June 1 - June 20. Under those regulations the bass maintained normal growth. During the 1953 legislature the law was extended to June 30. Our Big Lake study indicates that this 10-day extension serves no useful purpose, and

the law could revert to June 20 with benefit to both the angler and the fish. As we have already noted, the main value of a 'flies only' law for bass is that it enables the selective release of unharmed fish.

5. The use of minnows for bait should be restricted to those minnows that have been seined from tributaries of the Big Lake drainage. The minnow, known locally as 'live bait', is a lure of minor importance to the angler of the region. The selling of minnows for bait is a negligible part of the economy of the community. Tributaries of the Big Lake drainage sustain populations of minnows that could be seined to meet the limited demand for that bait without seriously depleting the forage fish of the region. The purpose of this section of the management plan is to eliminate the possibility of bass tapeworm being introduced by the few anglers who might bring in as bait small fish from infected waters.

6. Serious thought should be given to the possibility of permitting anglers to use *single-hooked* spin-casting and bait-casting artificial lures during the portion of the season that allows restricted fly-fishing for bass. Single-hooked artificial lures cast by a bait-casting rod or a spinning rod do not appear to be capable of catching any more fish than the ordinary fly rod. Many fishermen have sizable investments in spin-fishing and bait-casting equipment.

SUGGESTED READING

Sportsmen are encouraged to read further about the bass and its relationships with other fishes. The following books will be helpful:

1. *Fishes of Maine* by W. Harry Everhart, 1950. 53 pp.

   Gives brief clear life histories and identification keys for all fresh-water fishes of Maine.

   May be secured by writing to the Department of Inland Fisheries and Game, State House, Augusta, Maine.

2. *Maine Lakes* by the Fishery Research and Management Division, Maine Department of Inland Fisheries and Game. 1953.

   Gives a brief but complete account of Maine's lake types, and describes the Department's plan to provide for sportsmen a depth map and inventory of the fishes in each of Maine's lakes. This is a long-range project whose completion will demand continued field work for many years. The 14-page introduction and index are free; the maps themselves are sold for 5 cents each to help defray printing costs.

   May be secured by writing to the Department of Inland Fisheries and Game, State House, Augusta, Maine.

3. *A Study of Fish* by Chapman Pincher. 1947, 341 pp.

   Written by an English fishery scientist, this book is intended primarily for the sportsmen. No technical terms are used, but the book draws from the best fishery research of the past 20 years. It is well illustrated and answers almost any question a fisherman might have, from 'Can a fish see color?' to 'How does a fish breathe?'

   Published by Duell, Sloane, and Pearce, New York, N. Y.

SCIENTIFIC NAMES

The scientific names of the fishes and parasites referred to in this booklet are:

Fishes	
White Sucker	*Catostomus commersoni*
Chub (Fallfish)	*Semotilus corporalis*
Brown Bullhead (Hornpout)	*Amciurus nebulosus*
Chain Pickerel	*Esox niger*
Yellow Perch	*Perca flavescens*
Largemouth Bass	*Micropterus salmoides*
Smallmouth Bass	*Micropterus dolomieu* (several recent publications use the spelling *dolomieui*)
Yellowbelly Sunfish	*Lepomis auritus*
Pumpkinseed Sunfish	*Lepomis gibbosus*
White Perch	*Morone americana*
Parasites	
Yellow Grub	*Clinostomum marginatum*
Black Spot	*Uvulifer ambloplitis*
Bass Tapeworm	*Proteocephalus ambloplitis*

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the late Sam Tomah, former Governor of the Passamaquoddy Council in Indian Township.

And in that Heaven of all their wish,
There shall be no more Land — say Fish.

From — COLLECTED POEMS OF RUPERT BROOKE